UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Attorney Docket No.	001215	Total Pages	
First Named Inventor or Application Identifier			
Takashi SAITO and Katsuhiko UMEDA			
Express Mail Label No.			

Check Box, if applicable [ ] Duplicate

APPLICATION ELEMENTS FOR:
PLASMA DISPLAY DEVICE, AND METHOD FOR MANUFACTURING DISPLAY MODULE OF PLASMA DISPLAY DEVICE

ADDRESS TO: Director of Patents and Trademarks
BOX PATENT APPLICATIONS
Washington, D.C. 20231

1. [XX] Fee Transmittal Form (Incorporated within this form)
(Submit an original and a duplicate for fee processing)

2. [XX] Specification Total Pages [16]

3. [XX] Drawing(s) (35 USC 113) Total Sheets [4]

4. [XX] Oath or Declaration Total Pages [2]

a. [XX] Newly executed (original)

b. [ ] Copy from prior application (37 CFR 1.63(d)
(for continuation/divisional with Box 17 completed).

i. [ ] Deletion of Inventor(s)
Signed statement attached deleting inventor(s) named in prior application, see 37 CFR 1.63(d)(2) and 1.33(b).

5. [ ] Incorporation by reference (useable if box 4b is checked)
The entire disclosure of the prior application, from which a copy of the oath or declaration is supplied under Box 4b, is considered as being part of the disclosure of the accompanying application and is hereby incorporated by reference therein.

6. [ ] Microfiche Computer Program (Appendix)

7. [ ] Nucleotide and/or Amino Acid Sequence Submission (if applicable, all necessary)

a. [ ] Computer Readable Copy
b. [ ] Paper Copy (identical to computer copy)
c. [ ] Statement Verifying identity of above copies

ACCOMPANYING APPLICATION PARTS

8. [XX] Assignment Papers (cover sheet and document(s))

9. [ ] 37 CFR 3.73(b) Statement (when there is an assignee) [XX] Power of Attorney

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10. [ ] English translation Document (if applicable)

11. [ ] Information Disclosure Statement [ ] Copy of IDS Citation

12. [ ] Preliminary Amendment

13. [XX] Return Receipt Postcard (MPEP 503)

14. [ ] Small Entity Statement(s) [ ] Statement filed in prior application Status still proper and desired.

15. [XX] Claim for Convention Priority [1]Certified copy of Priority Document

a. Priority of _____ application no. _____ filed on _____ is claimed under 35 USC 119. The certified copies/copy have/has been filed in prior application Serial No. _____.
(For Continuing Applications, if applicable).

16. [ ] Other _____

17. If a CONTINUING APPLICATION, check appropriate box and supply the requisite information:

[ ] Continuation [ ] Division [ ] Continuation-in-part (CIP) of prior application no. _____/_____

FEE TRANSMITTAL The filing fee is calculated below	Number Filed	Number Extra	Rate	Basic . . Fee $690.00
Total Claims	11 - 20		x $18.00	
Independent Claims	3 - 3		x $78.00	
Multiple Dependent Claims			$260.00	$ 260.00
			Basic Filing Fee	$ 950.00
Reduction by 1/2 for small entity				
Fee for recording enclosed Assignment			$40.00	$ 40.00
TOTAL				$ 990.00

UTILITY PATENT APPLICATION TRANSMITTAL (Only for new nonprovisional applications under 37 CFR 1.53(b))	Attorney Docket No.	001215
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	PAGE 3 OF 3	

[XX] A check in the amount of $ 990.00 is enclosed to cover the filing fee of $ 950.00 and the assignment recordation fee of $40.00.

[ ] Please charge our Deposit Account No. **01-2340** in the total amount of _____ to cover the filing fee and the _____ assignment recordation fee. A duplicate of this sheet is attached.

[XX] The Commissioner is hereby authorized to charge payment for any additional filing fees required under 37 CFR 1.16 or credit any overpayment to Deposit Account No. **01-2340**. A duplicate of this sheet is attached.

18. CORRESPONDENCE ADDRESS

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Typed or Printed Name	Mel R. Quintos	Reg. No. 31,898
Signature	Mel R. Quintos	Date: September 29, 2000

MRQ/ll

PLASMA DISPLAY DEVICE, AND METHOD FOR MANUFACTURING DISPLAY MODULE OF PLASMA DISPLAY DEVICE

FIELD OF THE INVENTION

The present invention relates to a plasma display device.

DESCRIPTION OF THE RELATED ART

The plasma display device is a flat panel display capable of displaying color images by generating ultraviolet through high-voltage gas discharge, and lighting fluorescent agents of various colors painted to each pixel within the panel.

The technology related to plasma display devices has advanced remarkably during the recent years, and the plasma display devices have now reached a mass production state. There exists a competition in developing a large-size plasma display device that is bright, has a wide viewing angle, has an even luminance throughout the whole screen, and that is free from distortion, effusion or mismatch of colors.

However, according to the conventional plasma display devices, beautiful image is provided only when viewed in a dark room. The image provided by the plasma display is not bright enough to be viewed at a bright place, for example, outdoors.

The structure of a plasma display device according to the prior art is explained with reference to FIG. 5.

Electronics 3 are connected to a display module 10 through a flex lead 5. Tempered glass 9 is mounted on the display

surface of the display module 10 via space 7.

The display module 10 defines discharge spaces 20 by a back surface glass 11 placed to the side of the electronics 3, separation walls 15, and a front glass 13 placed to the side of the tempered glass 9 and superposed to the back surface glass 11 through the separation walls. Data electrodes 12 are mounted on the back surface glass 11, and scan electrodes 14 are mounted on the front surface glass 13, which are covered with dielectric layers 18 and 19. Fluorescent 17 of three colors (17R, 17G, 17B) are applied on each discharge space corresponding to each pixel.

High voltage is impressed to electrodes 12 and 14 of the plasma display device formed as explained above, and gas discharge is performed within the discharge space 20 filled with neon gas including argon. Ultraviolet is generated in each discharge space 20, and causes the fluorescent 17 of the corresponding pixel to glow.

One cause of insufficient brightness of the plasma display device is that not all of the visible radiation from the fluorescent caused by the ultraviolet generated by the gas discharge is radiated toward the display surface or front glass 12. Visible radiation is also radiated toward the back surface glass 11 and the side surfaces (separation walls 15), and perpendicular members (such as glass) absorb the visible radiation.

In order to improve the radiation efficiency toward the

display surface, there are attempts to color the dielectric layer 18 mounted to the back surface glass 11 white, so that it may reflect the visible radiation. However, the effect is not satisfying.

Moreover, many electronics 3 are mounted to the back surface of the display module 10. The heat generated from the display module 10 heats the electronics 3, causing trouble.

This is because the gas discharge and the fluorescent of the display module 10 generates electromagnetic wave (energy) having various wavelengths, such as ultraviolet, visible radiation, heat wave and radio wave. The white-colored dielectric layer 18 mounted to the back surface of the module improves the luminance of the display by reflecting the visible radiation (electromagnetic wave having a wavelength of 0.38 - 0.78 micron) generated from the fluorescent. However, the white dielectric layer does not reflect electromagnetic wave having a long wavelength (0.78 - 100 micron) called the heat wave, or radio wave (electromagnetic wave having a wavelength of 100 micron or greater).

Even further, the electromagnetic wave that has not been reflected by the dielectric layer is absorbed by the fluorescent, the white-colored dielectric layer 18 formed on the back surface, and the back surface glass plate 11 of the display module 10, and there, the electromagnetic wave is converted into heat energy. The heat energy causes the temperature of the back surface portion of the display module 10 to increase.

From the above reasons, there is a need to forcedly diffuse the heat of the display module, not only to protect the module but also to protect the electronics connected to the module.

SUMMARY OF THE INVENTION

The present invention aims at providing a plasma display device having improved luminosity and bright image quality with low consumption power, with reduced electromagnetic wave radiated toward the back surface of the display module equipped with electronics converting into heat energy.

The plasma display device according to the present invention comprises a display module equipped with an array of luminescent pixels, and electronics connected to the back surface of the display module; wherein the front surface of the display module is a display surface, and the surface of the luminescent pixels opposite said display surface is a reflection surface.

The display module of the plasma display device according to the present invention comprises a back surface glass plate having discharge electrodes and to which are connected electronics; a front surface glass plate mounted on and opposing to the back surface glass plate via separation walls and having discharge electrodes; and luminescent pixels defined by the back surface glass plate, the separation walls and the front surface glass plate; wherein the luminescent pixels are formed so that at least the surface of the back surface glass plate

opposite the display surface is a reflection surface. In another example, the luminescent pixels of the display module are formed so that all surfaces other than the surface of the front surface glass plate are reflection surfaces.

According to another aspect of the invention, the reflection surface is formed by metal plating, or by adhering metal leafs. In another example, the reflection surface opposing the display surface has a concave surface, and the light reflected from the reflection surface is condensed at the display surface.

A method for manufacturing a display module of a plasma display device according to the present invention comprises mounting electrodes covered with dielectric on a back surface glass plate and on a front surface glass plate; mounting separation walls on the back surface glass plate, thereby forming discharge space; forming a reflection surface on walls of each discharge space; and superposing the front surface glass plate functioning as a display surface on the separation walls opposite the back surface glass plate, thereby forming luminescent pixels.

According to the present invention, the shape of the discharge spaces (luminescent pixels) are changed, and reflection surfaces formed by metal plating and the like are provided to the areas that are expected to reflect the electromagnetic wave. Thereby, any electromagnetic wave regardless of their wavelength can be reflected toward the front

direction of the pixel to improve the brightness of the display, and to minimize the radiation of energy toward the back surface of the module.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an explanatory cross-sectional view showing the structure of a display module of the plasma display device according to the present invention;

FIG. 2 is a perspective view of a display module of the plasma display device according to the present invention;

FIG. 3 is an explanatory cross-sectional view showing another embodiment of the display module;

FIG. 4 is an explanatory cross-sectional view showing another embodiment of the display module;

FIG. 5 is an explanatory view of the structure of a plasma display device;

FIG. 6 is an explanatory view of the structure of a display module according to the prior art; and

FIG. 7 is an explanatory view of luminescent pixels.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

The preferred embodiments of the present invention will now be explained with reference to the drawings.

Embodiment 1

FIG. 1 is an explanatory cross-sectional view of one pixel of the display module according to the present invention. FIG.

2 is an explanatory view showing the structure of the display module.

The display module 100 comprises discharge spaces 110, each defined by a front glass plate 50, a back glass plate 60, and separation walls 70.

Electrodes 120 are mounted on the front glass plate 50, which are covered with a dielectric layer 52.

Electrodes 130 are mounted on the back glass plate 60, which are covered with a dielectric layer 62.

Metal plating treatment is provided to the surface of the dielectric layer 62 covering the back glass plate 60 and the surface of the separation wall 70, thereby forming a reflection surface 80. Further, fluorescent agent is applied to the reflection surface 80 to form a fluorescent layer 85. In other words, the reflection surface 80 and the fluorescent layer 85 are provided to all inner surfaces of each discharge space 110 except for the display surface near the front glass plate 50.

According to the display module 100 formed as explained above, high voltage impressed to the electrodes 120 and electrodes 130 causes discharge to occur within each discharge space 110, and generates ultraviolet. Ultraviolet lights the fluorescent surface 85. The light is reflected by the reflection surface 80, and the reflected light is radiated toward the front glass plate 50 having no reflection surface (in the direction of the display surface).

Next, the method for manufacturing the display module 10

equipped with a reflecting surface is explained.

First, electrodes 130 and 120 covered with dielectric 62 and 52 are formed on the back surface glass plate 60 and on the front surface glass plate 50. Thereafter, separation walls 70 are mounted on the back surface glass plate 60, thereby defining the ditch for forming the discharge space 110.

Next, a metal plating treatment and the like is applied to each of the inner wall surfaces of the discharge space 110, that is, on the surface of the dielectric 62 placed on the back surface glass plate 60 and on the wall surfaces of the separation wall 70, in order to form the reflection surface 80. Thereafter, a fluorescent layer 85 is formed on the reflection surface 80 by applying fluorescent paint thereto.

Further, the front surface glass plate 50 is superposed on the upper area of the separation walls 70. The back surface glass plate 60, the separation wall 70 and the front surface glass plate 50 define a closed discharge space 110.

Discharge is performed within each of the discharge spaces (pixels) 110 of the display module 100 formed as above. Each luminescent pixel is lighted by the ultraviolet generated by the discharge performed within each pixel, and generates light according to the fluorescent paint. All of the generated light is reflected by the reflection surface 80 toward the front surface glass plate 50, without being absorbed by the separation walls 70 or the back surface glass plate 60. The surface luminance of the display module 100 utilizing the front surface

glass plate 50 as the display surface is improved by the reflected light, and the surface becomes brighter.

Moreover, the metal-plated reflection surface 80 not only reflects visible light and ultraviolet, but also reflects all electromagnetic wave regardless of their wavelength. Visible light, electromagnetic wave with long wavelength, and radio wave are all reflected by the reflection surface 80, and will not be absorbed by the back surface glass plate 60. As a result, no energy causing temperature rise will reach the electronics equipped to the back surface of the module.

Embodiment 2

Another embodiment for improving the luminance of the display surface of the module is explained with reference to FIG. 3.

The display module 200 defines the discharge space 110 by the front surface glass plate 50, the back surface glass plate 60 and the separation wall 70. Electrodes 120 are mounted to the front surface glass plate 50 and electrodes 130 are mounted on the back surface glass plate 60, which are covered with dielectric layers. Such structure is similar to the display module 100 of embodiment 1.

In the present embodiment, the dielectric layer 620 covering the back surface glass plate 60 comprises a concave surface 625 positioned at the center of each discharge space. Sandblasting is applied to the concave surface 625 to form a concave mirror-like surface. Thereafter, metal plating is

applied to the concave surface 625 to form a reflection surface 800. Then, fluorescent agent is applied on the surface of the metal-plated reflection surface 800, forming the fluorescent layer 850.

The display module 200 according to the present embodiment is characterized in that the visible light generated by the fluorescent layer 850 is all reflected by the reflection surface 800 having a concave surface, and the light is collected toward the front surface glass plate 50 functioning as the display surface. Therefore, the surface luminance of the display module 200 is improved greatly. Moreover, since the reflection surface 800 having a concave surface reflects all electromagnetic wave regardless of their wavelength, so the back surface glass plate 60 will absorb no electromagnetic wave. As a result, the electromagnetic wave will not heat the electronics mounted to the back surface glass plate 60.

Embodiment 3

Another embodiment of the present invention is explained with reference to FIG. 4.

The present display module is similar to the display module 100 of embodiment 1 in that discharge spaces 110 are defined by the separation walls 70, the front surface glass plate 50, and the back surface glass plate 60, and that electrodes 120 are mounted on the front surface glass plate 50 and electrodes 130 are mounted on the back surface glass plate 60, which are covered by dielectric layers 52 and 62. The display module 300

is further equipped with a reflection surface 870 formed on a back surface 60b of the back surface glass plate 60.

The reflection surface 870 is either formed by metal plating, or by metal leafs adhered on the back surface 60b.

The display module 300 reflects light by a front surface 60a of the back surface glass plate 60. The light transmitted through the back surface glass plate 60 is reflected by the reflection surface 870 toward the display surface or front surface glass plate 50. A portion of the electromagnetic wave absorbed by the back surface glass plate 60 may turn into energy and cause temperature of the back surface 60b of the back surface glass plate 60 to rise. However, since most of the electromagnetic wave absorbed is reflected by the reflection surface 870, the rising of temperature is held to a low level. Even further, the module of the present embodiment has a simple structure, and has high reflect efficiency.

As explained, the display module according to the present embodiment reflects all of the visible light generated by the fluorescent body by the reflection mirror toward the display surface, and improves the luminance of the display surface greatly. Even further, since the reflection surface of the module reflects all electromagnetic wave regardless of their wavelength, the temperature of the electronics mounted to the back surface of the module is prevented from rising.

The present invention provides a display module of a plasma display device that solves the problem of heat diffusion of

electronics mounted to the back surface of the module, with improved surface luminance, and with a display surface that is bright and provides good image quality, without rising consumption power.

We claim:

1. A plasma display device comprising a display module equipped with an array of luminescent pixels, and electronics connected to the back surface of said display module;

wherein the front surface of said display module is a display surface, and the surface of said luminescent pixels opposite said display surface is a reflection surface.

2. A plasma display device comprising a display module, said display module having electronics mounted to the back surface thereof and utilizing the front surface thereof as a display surface, said display module further comprising:

a back surface glass plate having discharge electrodes;

a front surface glass plate that is mounted on and opposing to said back surface glass plate via separation walls and having discharge electrodes; and

luminescent pixels defined by said back surface glass plate, said separation walls and said front surface glass plate;

wherein said luminescent pixels are formed so that at least the surface of said back surface glass plate opposite said display surface is a reflection surface.

3. The plasma display device according to claim 1 or claim 2, wherein said luminescent pixels of said display module are formed so that all surfaces other than the surface of said front surface glass plate are reflection surfaces.

4. The plasma display device according to claim 1 or claim 2, wherein said reflection surface is formed by metal plating.

5. The plasma display device according to claim 1 or claim 2, wherein said reflection surface is formed by adhering metal leafs.

6. The plasma display device according to claim 1 or claim 2, wherein the reflection surface opposite said display surface has a concave surface, and the light reflected from said reflection surface is condensed at the display surface.

7. A method for manufacturing a display module of a plasma display device, said display module having electronics equipped to the back surface thereof and utilizing the front surface thereof as a display surface, said method comprising the steps of:

mounting electrodes covered with dielectric on a back surface glass plate and on a front surface glass plate;

mounting separation walls on said back surface glass plate, thereby forming discharge spaces;

forming a reflection surface on a wall of each said discharge space; and

superposing said front surface glass plate functioning as a display surface on said separation walls opposite said back

surface glass plate, thereby forming luminescent pixels;

wherein said reflection surface is formed at least to the back surface glass plate opposite said display surface during the reflection surface forming step.

ABSTRACT

The plasma display device of the present invention comprises a back surface glass plate 60 equipped with discharge electrodes 130 and having electronics connected to the back surface thereof, a front surface glass plate 50 mounted on and opposing to said back surface glass plate via separation walls 70 and having discharge electrodes 120, and luminescent pixels 110 defined by said back surface glass plate 60, said separation wall 70 and said front surface glass plate 50. The back surface glass plate 60 of the luminescent pixel opposite the display surface is formed as a reflection surface 80, and a fluorescent layer 85 is formed on said reflection surface 80.

Fig. 1

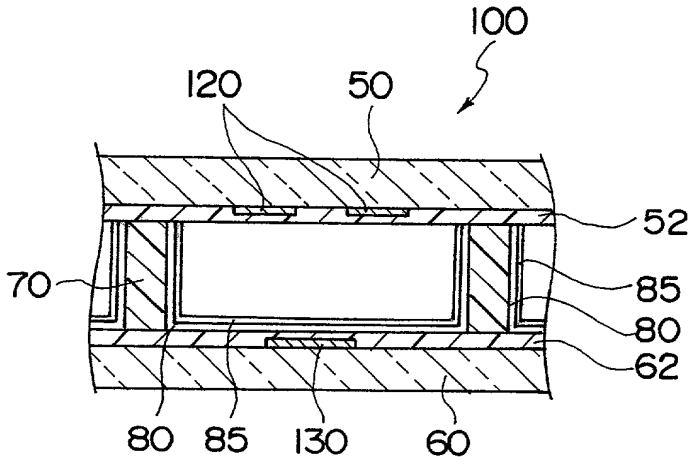


Fig. 2

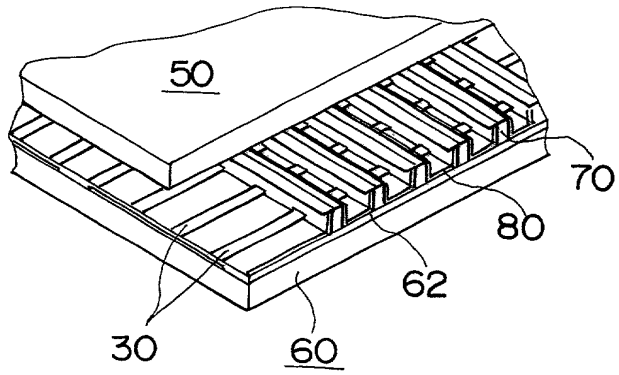
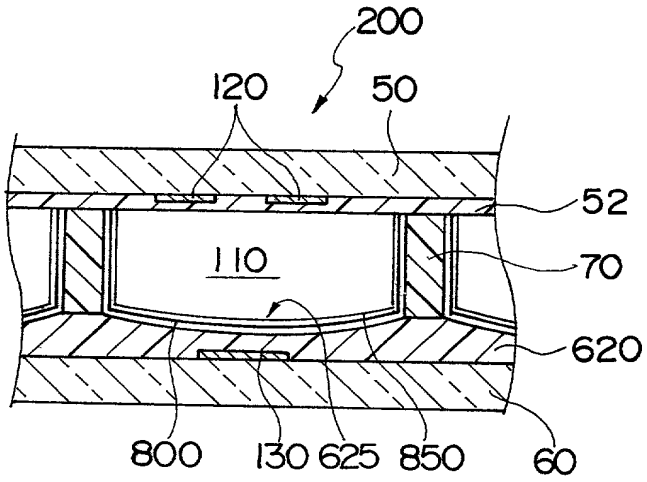


Fig. 3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52
110
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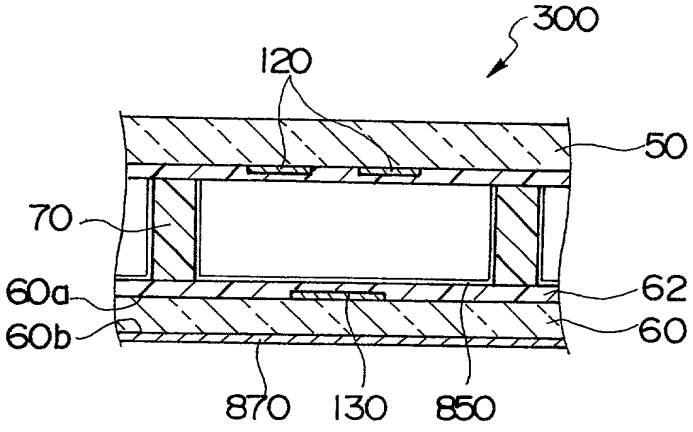
620
800
130
625
850
60

Fig. 4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120
50
70
60a
60b
62
60
870
130
850

Fig. 5

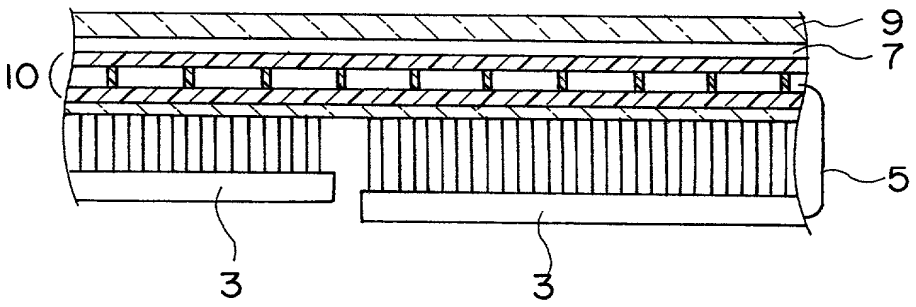


Fig. 6

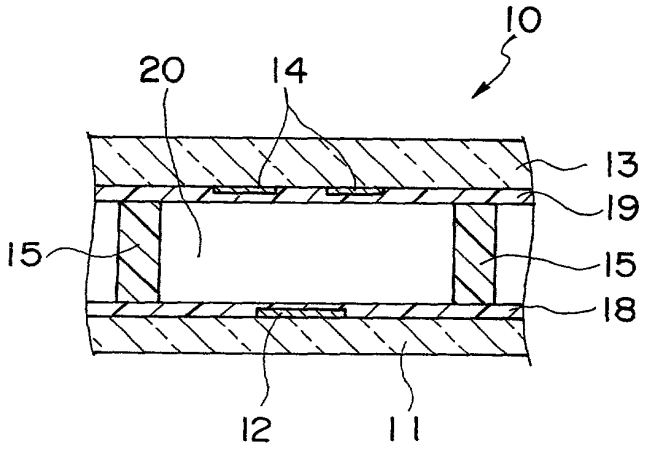
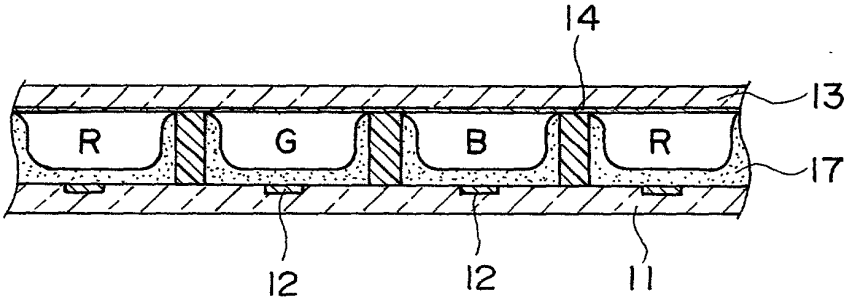


Fig. 7



A, W, H, McL & N Docket No._____ ARMSTRONG, WESTERMAN, HATTORI, McLELAND & NAUGHTON

Declaration For U.S. Patent Application

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention **entitled**
(Insert Title) PLASMA DISPLAY DEVICE, AND METHOD FOR MANUFACTURING DISPLAY MODULE OF PLASMA DISPLAY DEVICE
the specification of which is attached hereto unless the following is checked:

☐ was filed on _____ as United States Application Number or PCT International Application Number _____ and was amended on _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claim(s), as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, § 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, § 119 (a) - (d) of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

(List prior foreign applications. See note A on back of this page)	(Number)	(Country)	(Day/Month/Year Filed)	Priority Claimed
	H11-299369	JAPAN	21 October, 1999	☒ Yes ☐ No
				☐ Yes ☐ No
				☐ Yes ☐ No
				☐ Yes ☐ No

(See note B on back of this page) ☐ See attached list for additional prior foreign applications

I hereby claim the benefit under Title 35, United States Code, § 119(e) of any United States provisional application(s) listed below.

(Application Number)	(Filing Date)

I hereby claim the benefit under Title 35, United States Code, § 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, § 112, I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, § 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of the application:

(List Prior U.S. Applications)	(Application Serial Number)	(Filing Date)	(Status) (patented, pending, abandoned)

I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith:

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Title 18 of the United States Code, § 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

(See note C above)

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Inventor's Signature T. Saito Date Aug. 1st. 2000

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Full name of second inventor (given name, family name) Katsuhiko UMEDA

Inventor's Signature K. Umeda Date July 25th 2000

Residence Same as Post Office Address Citizenship Japan

Post Office Address c/o JAMCO CORPORATION
6-11-25, Osawa, Mitaka, Tokyo, Japan

Full name of third inventor (given name, family name) _____

Inventor's Signature _____ Date _____

Residence _____ Citizenship _____

Post Office Address _____

Full name of fourth inventor (given name, family name) _____

Inventor's Signature _____ Date _____

Residence _____ Citizenship _____

Post Office Address _____

Full name of fifth inventor (given name, family name) _____

Inventor's Signature _____ Date _____

Residence _____ Citizenship _____

Post Office Address _____

Full name of sixth inventor (given name, family name) _____

Inventor's Signature _____ Date _____

Residence _____ Citizenship _____

Post Office Address _____

Full name of seventh inventor (given name, family name) _____

Inventor's Signature _____ Date _____

Residence _____ Citizenship _____

Post Office Address _____

Full name of eighth inventor (given name, family name) _____

Inventor's Signature _____ Date _____

Residence _____ Citizenship _____

Post Office Address _____